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EXAMINER	
WANG, BEN C	

ART UNIT	PAPER NUMBER
2192	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/772,555	SMITH ET AL.	
	Examiner	Art Unit	
	BEN C. WANG	2192	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *05 February 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-23* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-23* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *03/06/2006*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

1. Claims 1-23 are pending in this application and presented for examination.

Arrangement of the Specification

As provided in 37 CFR 1.77(b), the specification of a utility application should include the following sections in order. Each of the lettered items should appear in upper case, without underlining or bold type, as a section heading. If no text follows the section heading, the phrase "Not Applicable" should follow the section heading:

(a) TITLE OF THE INVENTION.
(b) CROSS-REFERENCE TO RELATED APPLICATIONS.
(c) STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT.
(d) THE NAMES OF THE PARTIES TO A JOINT RESEARCH AGREEMENT.
(e) INCORPORATION-BY-REFERENCE OF MATERIAL SUBMITTED ON A COMPACT DISC.
(f) BACKGROUND OF THE INVENTION.
    (1) Field of the Invention.
    (2) Description of Related Art including information disclosed under 37 CFR 1.97 and 1.98.
(g) BRIEF SUMMARY OF THE INVENTION.
(h) BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING(S).
(i) DETAILED DESCRIPTION OF THE INVENTION.
(j) CLAIM OR CLAIMS (commencing on a separate sheet).
(k) ABSTRACT OF THE DISCLOSURE (commencing on a separate sheet).
(l) SEQUENCE LISTING (See MPEP § 2424 and 37 CFR 1.821-1.825. A "Sequence Listing" is required on paper if the application discloses a nucleotide or amino acid sequence as defined in 37 CFR 1.821(a) and if the required "Sequence Listing" is not submitted as an electronic document on compact disc).

Specification Objections

2. The specification is objected to because the following informalities:

- Section (g) which should address a brief summary of the invention regarding "identifying program phase changes through program working set analysis"
- Section (k) is a brief narrative of the disclosure as a whole in a single paragraph of 150 words or less.

Appropriate correction is required (See MPEP § 608.01(b))

Claim Rejections – 35 USC § 101

35 U.S.C. 101 reads as follows:

Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

3. Claims 1-7 are rejected under 35 U.S.C 101 because the claims are directed to non-statutory subject matter.

4. **In claim 1**, "An apparatus comprising a data structure and a hash unit" (see page 4, lines 23-30 in the specification) are being cited; however, it appears that the apparatus would reasonably be interpreted by one of ordinary skill in the art as computer software listings per se, are not physical "things". They are neither computer components nor statutory processes, as they are not "act" being performed. Such claimed computer programs do not define any structural and functional interrelationships between the computer program and other claimed elements of a computer which permit the computer program's functionality to be realized.

In contrast, a claimed computer readable medium encoded with a computer program is a computer element which defines structural and functional interrelationships between the computer program and the rest of the computer which permit the computer program's functionality to be realized, and is thus statutory. Accordingly, it is important to distinguish claims that define descriptive material per se from claims that define statutory inventions. (See MPEP 2106.01(I))

5. **As to claims 2-7**, the claims fail to remedy the deficiencies as noted above, thus also being rejected under the same rational.

Claim Rejections – 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:
The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

6. Claims 2, 6, and 14 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

7. **As to claim 2**, recited in line 1, where "n" and "m" lack proper antecedent basis.

8. **As to claim 6**, recited in line 1, where "n" lacks proper antecedent basis.

9. **As to claim 14**, recited in line 2, where "an instruction retirement unit" lacks proper antecedent basis.

Claim Rejections – 35 USC § 102(e)

The following is quotation of 35 U.S.C. 102(e) which form the basis for all obviousness rejections set forth in this office action:

> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

10. Claims 1-23 are rejected under 35 U.S.C. 102(e) as being anticipated by Calder et al. (Pub. No. US 2004/0111708 A1) (hereinafter 'Calder')

11. **As to claim 1**, Calder discloses an apparatus comprising:

- a data structure to collect a representation of a working set (e.g., [0071] … by tracking a component for a statistic, an interval vector (IV) may be created, which can concisely summarize the behavior of an arbitrary section of execution in program. an interval vector as used ... single-dimensional array representing a particular sampled interval ...); and
- a hash unit to map a plurality of working set elements into the data structure using a hash function (e.g., [0225], … the ranch ID is then reduced to a number of buckets between 1 and N using a hash function …; [0226] – a preferred hash function used for the phase classification architecture is a random projection … this hashing scheme is ….).

12. **As to claim 2** (incorporating the rejection in claim 1), Calder discloses the apparatus wherein the data structure is a 2^n x m bit table (e.g., [0071] - … an interval

vector (IV) may be created, which can concisely summarize the behavior of an arbitrary section of execution in a program. An interval vector as used herein refers to a preferable single-dimensional array representing a particular sampled interval ...).

13. **As to claim 3** (incorporating the rejection in claim 2), Calder discloses the apparatus wherein m is in the range of 1 to 64 (e.g., [0217] - ... 64 entry re-order buffer ...)

14. **As to claim 4** (incorporating the rejection in claim 2), Calder discloses the apparatus wherein m = 1 (e.g., [0071] - ... an interval vector (IV) may be created, which can concisely summarize the behavior of an arbitrary section of execution in a program. An interval vector as used herein refers to a preferable single-dimensional array representing a particular sampled interval ...)

15. **As to claim 5** (incorporating the rejection in claim 2), Calder discloses the apparatus wherein n is in the range of 1 to 20 (e.g., [0242] - ... shown as 20 on the x-axis ...)

16. **As to claim 6** (incorporating the rejection in claim 1), Calder does not disclose the apparatus wherein the data structure is a 2^n-bit vector (e.g., [0071] - ... an interval vector (IV) may be created, which can concisely summarize the behavior of an arbitrary

section of execution in a program. An interval vector as used herein refers to a preferable single-dimensional array representing a particular sampled interval ...)

17. **As to claim 7** (incorporating the rejection in claim 6), Calder does not disclose the apparatus wherein n = 1 (e.g., [0116] - ... an 8K entry 2-bit chooser table is used to choose between an 8K entry 2-bit bi-modal branch predictor ...)

18. **As to claim 8**, Calder discloses a computerized method of creating a representation of a working set, the computerized method comprising:

- mapping a plurality of working set elements into fields of a data structure using a hash function (e.g., [0071] ... by tracking a component for a statistic, an interval vector (IV) may be created, which can concisely summarize the behavior of an arbitrary section of execution in program. an interval vector as used ... single-dimensional array representing a particular sampled interval ...; [0225], ... the ranch ID is then reduced to a number of buckets between 1 and N using a hash function ...; [0226] – a preferred hash function used for the phase classification architecture is a random projection ... this hashing scheme is ....)

19. **As to claim 9** (incorporating the rejection in claim 8), Calder discloses the computerized method wherein the mapping is performed for a fixed interval of program execution (e.g., [0071] ... by tracking a component for a statistic, an interval vector (IV) may be created, which can concisely summarize the behavior of an arbitrary section of

execution in program. an interval vector as used ... single-dimensional array representing a particular sampled interval ...)

20. **As to claim 10** (incorporating the rejection in claim 9), Calder discloses the computerized method wherein the data structure is reset prior to each fixed interval of program execution ([0218] - ... reset the statistics every 10 million instructions, and this was used as a base for evaluation)

21. **As to claim 11** (incorporating the rejection in claim 10), Calder discloses the computerized method further comprising saving the fields of the data structure prior to resetting the data structure (e.g., [0206] – a preferred phase tracking and prediction architecture is based on run-length encoding of past phase information, and creates a history based on both phase pattern and duration ...; [0207] - ... the phase prediction architecture compresses a history of phases and uses this history to predict the next phase to occur ...)

22. **As to claim 12**, Calder discloses a computerized method of creating a representation of a working set, the computerized method comprising:

- executing a program for a fixed interval, the program comprising instructions identified by a program counter (e.g., [0071] - ... by tracking a component for a statistic, an interval vector (IV) may be created, which can concisely summarize the

behavior of an arbitrary section of execution in program. an interval vector as used ... single-dimensional array representing a particular sampled interval ...);

- performing a hash function on the program counter to create a hash value for each instruction executed during the fixed interval; and
- updating a field of a table indexed by the hash value wherein the table represents the working set (e.g., [0225], ... the ranch ID is then reduced to a number of buckets between 1 and N using a hash function ...; [0226] – a preferred hash function used for the phase classification architecture is a random projection ... this hashing scheme is ....)

23. **As to claim 13**, Calder discloses a computer system comprising:

- a bus;
- a memory coupled to the bus (e.g., [0109] - ... memory hierarchy buses were pipelined ...); and
- a processor coupled to tile memory and the bus; the processor comprising:
  - a data structure to collect a representation of a working set (e.g., [0071] ... by tracking a component for a statistic, an interval vector (IV) may be created, which can concisely summarize the behavior of an arbitrary section of execution in program. an interval vector as used ... single-dimensional array representing a particular sampled interval ...); and
  - a hash unit to map a plurality of working set elements into the data structure using a hash function (e.g., [0225], ... the ranch ID is then reduced to a

number of buckets between 1 and N using a hash function …; [0226] – a preferred hash function used for the phase classification architecture is a random projection … this hashing scheme is ….)

24. **As to claim 14** (incorporating the rejection in claim 13), Calder discloses the computer system wherein the data structure and the hash unit are part of an instruction retirement unit (e.g., [0071] … by tracking a component for a statistic, an interval vector (IV) may be created, which can concisely summarize the behavior of an arbitrary section of execution in program. an interval vector as used ... single-dimensional array representing a particular sampled interval ...; [0225], … the ranch ID is then reduced to a number of buckets between 1 and N using a hash function …; [0226] – a preferred hash function used for the phase classification architecture is a random projection … this hashing scheme is ….).

25. **As to claim 15**, Calder discloses a computerized method of estimating size of a working set, the method comprising:

- Receiving a signature for a working set (e.g., [0056] - … the identified behavior for an interval provides a signature for that interval, …; [0072] - … a unique interval vector for a particular interval is referred to herein as an interval signature; [0074] - … interval signatures gathered for small portions of the program's execution are used to find behavior, and behavior may be compared to identify, for example, representative areas of the program to analyze …); and

- Estimating the size of the working set based on the size of the signature (e.g., [0136] - … various techniques are contemplated for sampling to estimate the behavior of the program as a whole …; [0154] – partitioning algorithms choose an initial solution and then use iterative updates to find a better solution … these algorithms tend to have a run time that is linear in the size of the dataset).

26. **As to claim 16** (incorporating the rejection in claim 15), Calder does not disclose the computerized method wherein the estimating is performed with the following function:

$$K = \log(1 - f) \Big/ \log\left(1 - \frac{1}{2^n}\right),$$

wherein K is the number of unique working set elements, 2^n is the number of entries in the signature, and f is the fraction of 1 's in the signature.

However, it is well known in the art of mathematical prediction equations to incorporate a logarithm of the probability of transitioning multipliers into equations in order to obtain the benefits know in the art.

27. **As to claim 17**, Calder discloses a computerized method of detecting working set changes, the method comprising:

- comparing a current working set signature to a previous working set signature (e.g., [0085] - … there are several ways of comparing two vectors to one another …; [0089] – with a way of comparing two IVs, it can be determined how the execution of a program changes over time …);

- calculating a relative signature distance between the current working set signature and the previous working set signature (e.g., [0086] – The Euclidean distance can found by treating each vector as a single point in D-dimensional space …; [0087] – the Manhattan distance, on the other hand, is the distance between tow points if the only paths you can take are parallel to the axes …); and
- identify a working set change when the relative signature distance exceeds a predetermined threshold (e.g., Fig. 32; [0242] - Fig. 32 shows a measured ability of an exemplary run-time method to phase changes (transitions between one phase and the next) when different thresholds are used to perform the phase classification ...).

28. **As to claim 18** (incorporating the rejection in claim 17), Calder discloses the computerized method wherein the working set change indicates a phase change in a program (e.g., [0085] - … there are several ways of comparing two vectors to one another …; [0089] – with a way of comparing two IVs, it can be determined how the execution of a program changes over time …; Fig. 32; [0242] - Fig. 32 shows a measured ability of an exemplary run-time method to phase changes (transitions between one phase and the next) when different thresholds are used to perform the phase classification ...)

29. **As to claim 19**, Calder discloses a computerized method of identifying a recurring working set, the method comprising:

- comparing a current working set signature to one or more previous working set signatures (e.g., [0085] - ... there are several ways of comparing two vectors to one another ...; [0089] – with a way of comparing two IVs, it can be determined how the execution of a program changes over time ...);
- calculating a relative signature distance between the current working set signature and the one or more previous working set signatures (e.g., [0086] – The Euclidean distance can found by treating each vector as a single point in D-dimensional space ...; [0087] – the Manhattan distance, on the other hand, is the distance between tow points if the only paths you can take are parallel to the axes ...); and
- identifying a recurring working set when the relative signature distance between the current working set signature and one of the previous working set signatures is within a predetermined threshold (e.g., Fig. 32; [0242] - Fig. 32 shows a measured ability of an exemplary run-time method to phase changes (transitions between one phase and the next) when different thresholds are used to perform the phase classification ...)

30. **As to claim 20** (incorporating the rejection in claim 19), Calder discloses the computerized method further comprising identifying a new working set when the relative signature distance between the current working set signature the one or more previous working set signatures exceeds a predetermined threshold (e.g., [0085] - ... there are several ways of comparing two vectors to one another ...; [0089] – with a way of comparing two IVs, it can be determined how the execution of a program changes over

time ...; [0086] – The Euclidean distance can found by treating each vector as a single point in D-dimensional space ...; [0087] – the Manhattan distance, on the other hand, is the distance between tow points if the only paths you can take are parallel to the axes ...; Fig. 32; [0242] - Fig. 32 shows a measured ability of an exemplary run-time method to phase changes (transitions between one phase and the next) when different thresholds are used to perform the phase classification ...)

31. **As to claim 21** (incorporating the rejection in claim 20), Calder discloses the computerized method further comprising maintaining a table of the one or more previous working set signatures e.g., [0085] - ... there are several ways of comparing two vectors to one another ...; [0089] – with a way of comparing two IVs, it can be determined how the execution of a program changes over time ...)

32. **As to claim 22**, Calder discloses a hardware reconfiguration method comprising:

- maintaining a table comprising a plurality of working set signatures for a program (e.g., [0071] ... by tracking a component for a statistic, an interval vector (IV) may be created, which can concisely summarize the behavior of an arbitrary section of execution in program. an interval vector as used ... single-dimensional array representing a particular sampled interval ...);
- upon detecting a working set change, looking up a working set signature for a current working set in the table (e.g., [0085] - ... there are several ways of

comparing two vectors to one another …; [0089] – with a way of comparing two IVs, it can be determined how the execution of a program changes over time …);

- if the working set signature is in the table, reinstating a hardware configuration for the current working set; and
- if the working set signature is not in the table; identifying a new hardware configuration for the current working set and saving the working set signature and the new hardware configuration (e.g., Fig. 32; [0242] - Fig. 32 shows a measured ability of an exemplary run-time method to phase changes (transitions between one phase and the next) when different thresholds are used to perform the phase classification ...).

33. **As to claim 23** (incorporating the rejection in claim 22), Calder discloses the method wherein the working set change indicates a phase change (e.g., [0085] - … there are several ways of comparing two vectors to one another …; [0089] – with a way of comparing two IVs, it can be determined how the execution of a program changes over time …; Fig. 32; [0242] - Fig. 32 shows a measured ability of an exemplary run-time method to phase changes (transitions between one phase and the next) when different thresholds are used to perform the phase classification ...)

Conclusion

34. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ben C. Wang whose telephone number is 571-270-1240. The examiner can normally be reached on Monday - Friday, 8:00 a.m. - 5:00 p.m., EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tuan Q. Dam can be reached on 571-272-3695. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Ben C Wang/
Examiner, Art Unit 219
March 31, 2008

/Tuan Q. Dam/
Supervisory Patent Examiner, Art Unit 2192